Coralliophila kaofitorum, a new species (Gastropoda: Coralliophilidae) from the Canary Islands living on *Antipathes wollastoni* (Cnidaria: Anthozoa: Antipatharia)

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ABSTRACT

A new species of *Coralliophila* from the Canary Islands living on the antipatharian *Antipathes wollastoni* is described. The new species differs from its closest Eastern Atlantic relative *Coralliophila brevis* (Blainville, 1832) by its smaller size and spiral cords of similar width, and from the Western Atlantic *Coralliophila caribaea* Abbott, 1958, by having a thinner shell and narrower aperture and by the sculpture and smaller size of the protoconch. Additional remarks on the taxonomy and feeding of some Eastern Atlantic and Mediterranean Coralliophilidae are included.

INTRODUCTION

The family Coralliophilidae comprises tropical to temperate, shallow- to deep-water marine species that live and feed on cnidarians. The conchological characters may vary greatly within the family, and there are different grades of interspecific and intraspecific variation. Shell variability, together with the rarity of most of the species due to their restricted habitat (specially those living in deep water), the absence of radula, the absence of protoconch (usually eroded in adults and even in young specimens), and the poor knowledge of anatomy and biology have led to a confused taxonomy of the family that makes it the generic allocation of species difficult. The Coralliophilidae has been traditionally considered [illegible] closely related to Muricidae, but Pond[illegible]1988), without further discussion, proposed [illegible] is a subfamily of Muricidae. This taxo[illegible] been adopted by some subsequent author[illegible] Riedel 2000). However, Kantor 1995 [illegible] ough differences in foregut anatomy to [illegible] tion into two different families. Since the [illegible] ilies of the Coralliophilidae is currently und[illegible] e prefer to use the traditionally accepted ranking of the taxon at the family level.

No critical revisions of the family have been published except for that of Massin (1982) for the genera *Magilus* and *Leptoconchus*, but two catalogues (D'Attilio, 1978; Kosuge and Suzuki, 1985) consider about 200 Recent species. At least 27 genera have been described, but the actual number is probably smaller (D'Attilio and Bertsch, 1979; Kosuge and Suzuki, 1985); a large number of species (about 80) are included in the genus *Coralliophila* H. and A. Adams, 1853, but this genus still needs to be better defined. Most coralliophilids feed on scleractinian corals, but there are also species that feed on Gorgonacea, Corallimorpharia, Zoanthidea (Miller, 1981; Robertson, 1970, 1981; Wicksten and Wright, 1993), Actiniaria (Spada, 1979; Oliverio, 1989a), and Alcyonacea (Lorenz, 1996). Only two species of *Rhizochilus* (*Rhizochilus antipathum* Steenstrup, 1850, and *Rhizochilus* sp.) and *Coralliobia cumingii* (H. and A. Adams, 1863) are known to feed on Antipatharia in the Indo-Pacific (Kay, 1979; Poorman, 1981; Kosuge and Suzuki, 1985; D'Attilio and Kosuge, 1988). The type of feeding and the degree of association with anthozoans vary from boring, endobiotic, almost parasitic, highly host-selective species (*Magilus*, *Leptoconchus*, *Reliquiaecava*) (Massin, 1982, 1983, 1987, 1988, 1990), to less selective species with a relatively high mobility (*Coralliophila*) (Miller, 1981).

References to Eastern Atlantic coralliophilids are scattered in publications from different areas: Mediterranean and European Atlantic (Sabelli and Spada, 1980; Oliverio, 1989a, b; Poppe and Goto, 1991), continental West Africa (Knudsen, 1956; Bernard, 1984; Talavera, 1975; Gofas, Pinto-Afonso and Brandão, 1985; Kosuge and Fernandes, 1988, Smriglio and Mariottini, 2000), deep waters of the northeastern Atlantic (Bouchet and Warén, 1985), Cape Verde Islands (Cosel, 1982), São Tomé Island (Kosuge and Fernandes, 1989, Rolán and Fernandes, 1990), Saint Helena Island (Smith, 1890), and Tristan da Cunha Island (Watson, 1886). Four spe-

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cies were recorded from the Canary Islands by Nordsieck and García-Talavera (1979): *Coralliophila meyendorffii* (Calcara, 1845), *C. brevis* (Blainville, 1832), *Babelomurex cariniferus* (G. B. Sowerby, 1834) (as *Coralliophila babelis* (Réquien, 1848)), and *Coralliophila richardi* (P. Fischer, 1882) (as *C. lactuca* (Dall, 1889)). In addition to *C. richardi*, two additional deep-sea species are known from the Canary Islands: *C. squamosa* (Bivona, 1838) and *C. basileus* (Dautzenberg and Fischer, 1896) (Bouchet and Warén, 1985). Finally, *Coralliophila fontanangioyi* Smriglio and Mariottini, 2000, has been recently described from Tenerife.

During SCUBA-diving sampling around the island of Tenerife (Canary Islands), a coralliophilid living on the black coral *Antipathes wollastoni* (Gray) has been found. This third species of the family known to live on antipatharians is described here as a new species, since it shows clear differences from the previously known coralliophilids from the Atlantic Ocean.

Institutional abbreviations used in this work are: BAU, Dipartimento di Biologia Animale e dell'Uomo, "La Sapienza" University, Rome, Italy; MNCN, Museo Nacional de Ciencias Naturales, Madrid, Spain; MCNT, Museo de Ciencias Naturales de Tenerife, Tenerife, Spain; DBUA, Departamento de Biología, Universidad Autónoma, Madrid, Spain.

SYSTEMATICS

Superfamily Muricoidea Rafinesque, 1915
Family Coralliophilidae Chenu, 1859
Genus *Coralliophila* H. and A. Adams, 1853

Type species: *Fusus neritoideus* Lamarck, 1816, by subsequent designation (Iredale, 1912). Recent, Indo-Pacific.

Coralliophila kaofitorum new species
(Figures 1–7)

Description: Shell (Figures 1–4) up to 24.6 mm of length, 15.5 mm width, solid but rather thin, ovoid-fusiform; spire high, conical, with up to 7 convex whorls, shoulder slightly angulate; suture well defined with undulate narrow groove. Shell color uniformly yellowish- or pale-brown, milky-white when cleaned. Protoconch (Figures 5–7) of about 3½–4 whorls, 1 mm length, 940 µm width, and diameter of first whorl 280 µm. Protoconch indicative of planktotrophic larval development. Protoconch nucleus (Figure 7) smooth except for small, scattered pustules, subsequent whorls with two strong spiral keels, crossed by axial ribs forming nodules at intersections and scattered, small pustules (Figure 6). Thick varix indicates limit between protoconch and teleoconch. Protoconch color pink to reddish- or pale-brown. Protoconch lacking or usually eroded in adult specimens, but when present is frequently somewhat tilted in relation to shell axis. Teleoconch with 5–7 convex whorls, somewhat angulate at shoulder on earlier whorls. Last whorl large, convex, more or less angulate at shoulder, then narrowing toward base, representing almost 3/4 of total shell length. Aperture large, oval, lirate and white within; but one specimen with inner side of aperture pinkish. Outer lip thin, with finely serrated outer margin (margin rippled internally); inner lip slightly angulate in middle. Siphonal canal broad, moderately elongate, open, slightly recurved. Umbilical aperture absent. Axial sculpture of 9–11 (on specimens longer than 10 mm) or 8–9 (on smaller specimens) broad, elevated axial ribs on last whorl, and usually 10 axial ribs on penultimate whorl. Axial ribs less marked toward end of body whorl in longest specimens, but clearly marked in smaller (younger) specimens. Spiral sculpture on last whorl of up to 18–19 cords of rounded cross-section, all of similar width, and bearing prominent densely packed, fine and long, scale-like lamellae. Spiral cords 8–9 on the penultimate whorl. Shell usually covered by encrusting organisms (*Miniacina*, bryozoans, serpulid polychaetes, two different small species of bivalves, sponges and calcareous algae were observed on a single specimen). Living animal white or whitish, including tentacles and siphon, with densely-packed, yellow speckles, which form a ring on distal part of the siphon. Operculum brown, mahogany-, or reddish-brown.

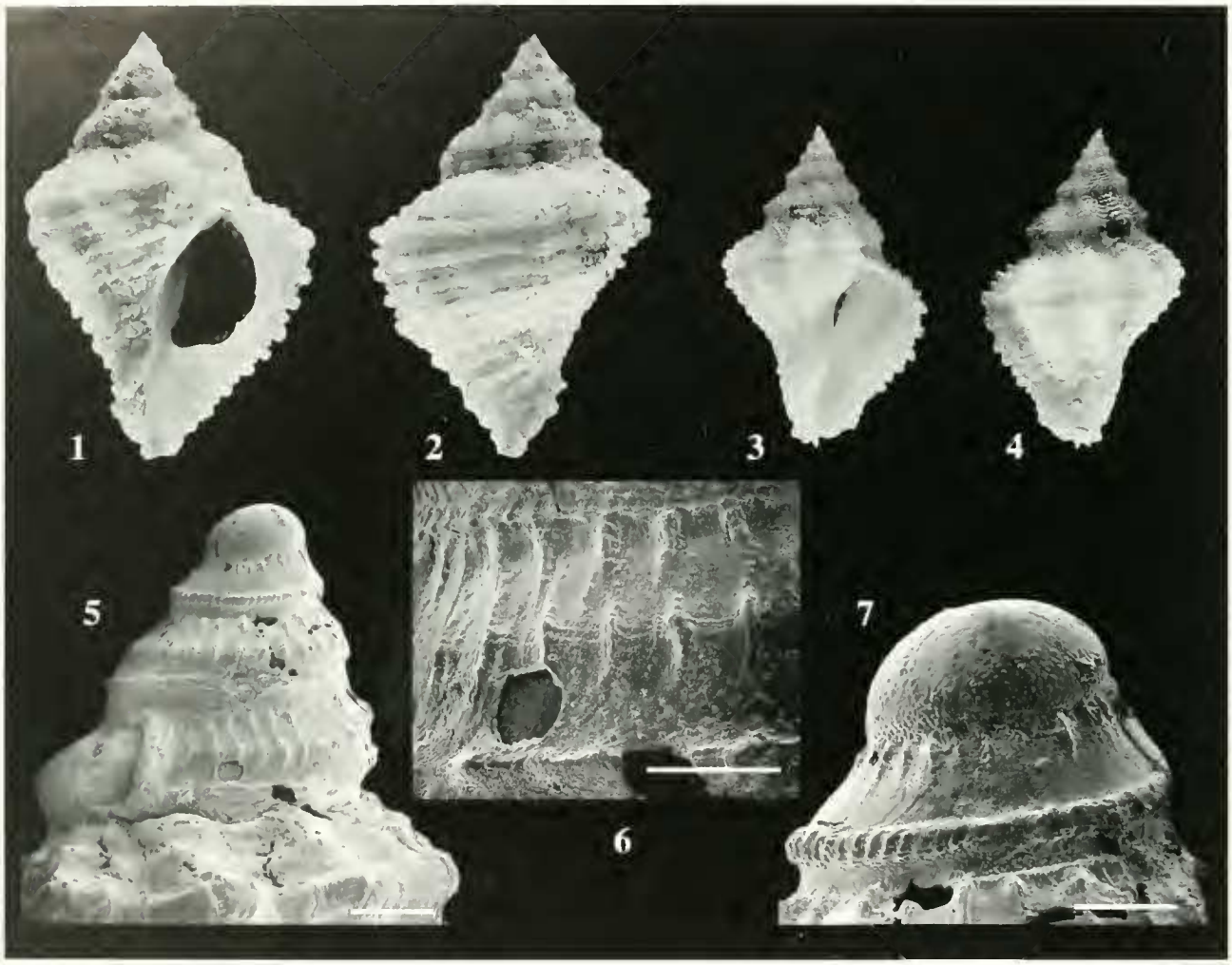
Type Material: Holotype (Figures 1–2), MNCN 15.05/32383, 20.0 mm length × 13.5 mm width; five paratypes, MNCN 15.05/32383; two paratypes, MCNT TFMCBMMO 000277 and TFMCBMMO 000278; two paratypes, DBUA, 15.05 18. All from type locality, attached to black coral *Antipathes wollastoni* (Gray), Nov.–Dec. 1994.

Type Locality: Punta de Teno, Tenerife, Canary Islands, 28°20′ N, 17°55′ W, depth 22–24 m.

Other Material Examined: Twelve specimens from the type locality, Ricardo and Rodolfo Vega Collection, type locality, R. and R. Vega coll., Nov.–Dec. 1994; 18 specimens, BAU, Punta de Teno; 12 specimens, BAU, Diente de Ajo; 21 specimens, BAU, Veril de Masca; all Tenerife, Canary Islands, M. Oliverio coll.; one specimen, 20.9 mm length × 13.6 mm width, R. and R. Vega Collection, La Bombilla, Palma Island, Canary Islands, collected alive on *Antipathes wollastoni* 40 m depth, D. R. Calloway coll., 24 Aug. 1996.

Distribution: Known only from the type locality, Punta de Teno, two other nearby points on the Tenerife Island (Diente de Ajo and Veril de Masca), and from La Palma Island (La Bombilla, David Roig Calloway, leg.). The planktotrophic type of development indicated by the protoconch of *Coralliophila kaofitorum* suggests a wider distribution than that currently known, but the species has not yet been found in other Macaronesian Islands, the West African coast or the Mediterranean.

Habitat: All collected and observed specimens were found attached near the base of colonies of the black coral *Antipathes wollastoni* (Gray), or near the major branch nodes in the case of very large colonies, between



Figures 1–7. *Coralliophila kaofitorum* new species. **1, 2.** Holotype, MNCN, 15.05/32583, 24.6 × 15.5 mm, Punta de Teno, Tenerife, Canary Islands. **3, 4.** Paratype 1, MNCN, 15.05/32583, from the type locality, 14.9 × 9.6 mm. **5, 6, 7.** Protoconch of paratype 1. **5.** General view. Scale bar: 200 μm. **6.** Detail of the sculpture of the last whorl. Scale bar: 100 μm. **7.** Detail of the nucleus and the first whorl. Scale bar: 100 μm.

18–30 m, Punta de Teno and Diente de Ajo) and 42–48 m (Veril de Masca). An average number of 5–6 specimens per antipatharian colony were observed in Punta de Teno with a maximum of 10–12 specimens, and up to 20 on a single antipatharian colony in Veril de Masca. Of 27 specimens checked for their position on three colonies, 20 were with the siphon directed upwards and 7 downwards (pers. comm.). No observations of feeding habits or food have been made.

Etymology: The specific name combines to the nicknames of the first two authors: Kao (Ricardo) and Ohto (Enrique).

Remarks: *Coralliophila kaofitorum* is tentatively assigned to the genus *Coralliophila* because it resembles other species (*C. brevis*) that are presently included in that genus (see a generic revision of the family).

Coralliophila kaofitorum differs from its closest relative *Coralliophila brevis* (Blainville, 1832), which is also present in the Canary Islands and has been collected at the base of the yellow (*Lophogorgia viminalis*) and red (*L. ruberrima*) gorgonians, off Puerto de la Cruz, at 20–32 m depth, and off the northern side of the Teno Peninsula, in identical environmental conditions. *Coralliophila brevis* is a longer species (up to 30–40 mm), very variable, especially in spire length and shape of the aperture and the siphonal canal; the spiral sculpture consists of 15–25 often markedly imbricate, alternating broad and thin cords; frequently one or two more swollen cords on the upper part of the spire accentuate the carene of the whorl. In the Mediterranean, *Coralliophila brevis* lives also on gorgonians (*Paramuricea chamaeleon, Eunicella stricta, Lophogorgia sarmentosa*) (Oliverio, 1989b; Poppe and Goto, 1991).

Coralliophila caribaea Abbott, 1958, from the Western Atlantic is a similar species, but it is somewhat solid and has a wider aperture usually purple on the inside.

It lives on a variety of anthozoans including scleractinians, gorgonaceans, zoanthideans and Corallimorpharia (Wells and Lalli, 1977; Miller, 1981; De Jong and Coomans, 1988). The embryonic shell of *Coralliophila caribaea* was illustrated by Bandel (1975), and the protoconch and larval shell by De Jong and Coomans (1988) and Leal (1991). The protoconch of *C. caribaea* has its nucleus densely covered by small pustules, is somewhat longer (4.5 whorls, 1.2 mm length), and has more prominent nodules than that of *C. kaofitorum*. Presently molecular investigation is in progress by Marco Oliverio to assay the relationships of the new species with *Coralliophila brevis* and *Coralliophila caribaea*.

The new species also differs from *Coralliophila meyendorffii* (Calcara, 1845), another littoral species of the Canary Islands widely distributed along the Mediterranean and Eastern Atlantic, which has a longer (up to 40 mm) and more solid shell, with 5–6 teleoconch whorls with about 13–15 spiral cords and 8–10 strong axial ribs, canal rather short, and umbilical aperture. In the Canary Islands, *C. meyendorffii* preys on *Anemonia sulcata* (Pérez-Sánchez and Moreno-Batet, 1991), and in the Mediterranean the species is known to prey on *Anemonia sulcata*, *Cladocora caespitosa*, and *Balanophyllia europaea* (Sabelli and Spada, 1980; Oliverio, 1989b).

The Atlantic-Mediterranean *Coralliophila squamosa* (Bivona, 1838) has a longer (up to 40–50 mm) and more solid shell, with 8–10 axial ribs and 12–20 major spiral cords, alternating with the same number of lamellose cordlets, the siphonal canal is of medium length and the umbilical aperture evident (Bouchet and Warén, 1985; Oliverio, 1989b). *Coralliophila squamosa* preys on Gorgonacea or deep-sea scleractinians (Oliverio, 1989b). *Coralliophila monterosatoi* (Locard, 1897), from Spain, and *Coralliophila profundicola* Haas, 1949, from Bermuda, should be considered junior synonyms of *C. squamosa*, according, respectively, to Bouchet and Warén (1985), and Kosuge and Suzuki (1985).

Coralliophila basilcus (Dautzenberg and H. Fischer, 1896) reaches up to 27 mm, has a thicker shell and broader siphonal canal. It is found on the upper part of the insular slopes around Azores and the Canary Islands (Bouchet and Warén, 1985); its prey/host is unknown.

Coralliophila richardi (P. Fischer, 1882) is a deep-sea (bathyal) species that lives (and probably preys) on the scleractinians *Madrepora oculata* and *Lophelia pertusa* in other Eastern Atlantic localities (Bouchet and Warén, 1985; Oliverio, 1989b, and observations of the third author). The shell of this species is very different from typical *Coralliophila*, with 8–10 axial foliate varices instead of solid ribs and with relatively few spiral cords without the characteristic scaly sculpture. *Coralliophila richardi* is included by Kosuge and Suzuki (1985) in the genus *Enozamia* Iredale, 1929, along with the similar *Coralliophila jarli* Knudsen, 1956, found from Sierra Leone to Angola.

Coralliophila fontanangioyi Smriglio and Mariottini, 2000, described from Teno, Tenerife Island, is smaller (up to 7.5 mm) and has a solid biconical shell. It lives on the scleractinian *Madracis asperula* Milne-Edwards and Haime, 1850 (Pérez-Sánchez and Moreno-Batet, 1991; Smriglio and Mariottini, 2000; authors' observations in Tenerife), which probably is a Macaronesian endemism (Zibrowius, 1980). According to Smriglio and Mariottini (2000), *Coralliophila fontanangioyi* is similar to *Coralliophila alboangulata* (E. A. Smith, 1890) from St. Helena Island, *Coralliophila raramaculatus* Kosuge and Fernandes, 1989, from São Tomé, *Coralliophila paci* Petuch, 1987, from Florida, and *Coralliophila curta* Sowerby, 1894, from Mauritius Island; all of them clearly differ from *C. kaofitorum* by the smaller size and different shell shape.

The remaining coralliophilid species found in the Canary Islands, *Babelomurex cariniferus* (G. B. Sowerby, 1834) is included in a different genus on the basis of conchological and anatomical features (Kosuge and Suzuki, 1985; Richter and Luque, in press). This species preys on the scleractinian *Phyllangia mouchezi* (authors' observations), whereas in the Mediterranean it preys on *Cladocora caespitosa*, *Astroides calycularis* and *Polycyathus muellerae* (Oliverio, 1989b, and authors' observations); of these three latter species, only *Polycyathus muellerae* might possibly be found in the Canary Islands (Zibrowius, 1980).

One other, probably undescribed littoral species of coralliophilid is found in the Canary Islands living on the scleractinian *Dendrophyllia ramea* (from Lanzarote, 40–50 m, Gustavo Pérez Dionis and Marco Oliverio, pers. comm.). It is a large (up to 40 mm) and solid shell, very similar to that illustrated as *Coralliophila* cf. *jarli* from Gabon by Bernard (1984: pl. 29, fig. 120).

The remaining Mediterranean species of *Coralliophila* are all very different. *Coralliophila panormitana* (Monterosato, 1869) is solid, with 10 axial ribs and 22–24 spiral cords with small scales. This species lives at the base of *Paramuricea chamaleon* and associated to *Corallium rubrum* (Oliverio, 1989b) or *Epizoanthus arenaceus* (Templado et al., 1993). *Coralliophila sophiae* (Aradas and Benoit, 1876) has a solid, more or less globose shell, similar to *Coralliophila squamosa* in size, and lives in bottoms with strong coralligenous component; its diet is unknown (Oliverio, 1989b).

Among the eastern Atlantic species, *Coralliophila aedonius* (Watson, 1886) from Nightingale Island (Tristan da Cunha) has a strong shell, with a high, scalariform spire, relatively small aperture and umbilicus. *Coralliophila giton* (Dautzenberg, 1891) from the Cape Verde Islands and São Tomé is a smaller species (up to 20 mm), with a thick elongate fusiform shell usually eroded and incrusted, 7–9 broad axial ribs and about 27 spiral cords on the last whorl (Kosuge and Fernandes, 1989; Rolán and Fernandes, 1990). *Coralliophila atlantica* (E. A. Smith, 1890) from St. Helena Island is a solid, small species (17.2 mm), with low axial ribs and spiral cords with weak sculpture. *Coralliophila erythrostoma* (E. A. Smith, 1890), also from St. Helena is solid, sub-rhomboidal, and has a reddish aperture and evident umbilicus. *Coralliophila patruelis* (E. A. Smith, 1890), from St.

Helena, is small (10.5 mm). As far as we know, the three latter species are only known from type material, illustrated and briefly described by Kosuge and Suzuki (1985).

Coralliophila kraemmeri Knudsen, 1956, from Nigeria, and *Coralliophila marrati* Knudsen, 1956, from Liberia, have solid, umbilicated shells; the first one has 16 axial ribs and 14 spiral ridges on the body whorl, whereas *C. marrati* has rounded ribs and only 8 prominent spiral ridges (Knudsen, 1956).

Coralliophila occidentale Kosuge and Fernandes, 1988, from Angola is a small (up to 9.4 mm) and rather solid species. *Coralliophila adansoni* (Kosuge and Fernandes, 1989) from São Tomé is also solid and has the inner side of the aperture denticulate. Finally, *Coralliophila knudseni* Smriglio and Mariottini, 2000, from Ivory Coast and *Coralliophila schiottei* Smriglio and Mariottini, 2000, from Sierra Leone, are smaller and have biconical and more solid shells than *Coralliophila kaofitorum*.

The remaining western Atlantic species of *Coralliophila* are also different. *Coralliophila aberrans* (C. B. Adams, 1850) has a thick, globose shell with strong spiral cords. *Coralliophila galea* (Reeve, 1846) also has a more solid shell and wider aperture. *Coralliophila salebrosa* (H. and A. Adams, 1863) has an ovate-fusiform shell, with angulate spire, and *Coralliophila scalariformis* (Lamarck, 1822) has a scalariform profile.

RECOMMENDATION

The host of *Coralliophila kaofitorum*, the anthipatarian *Antipathes wollastoni*, forms in the Canary Islands a characteristic community on walls below 30 m of depth, but it can be found at shallower depths (18–24 m) in caves or overhangs at certain sites (Pérez-Sánchez and Moreno-Batet, 1991). A similar assemblage occurs in the Caribbean islands with other antipatharian species (*Antipathes* spp., Humann, 1993). *Antipathes wollastoni* is only known with certainty from Madeira, Selvagem and Canary Islands, but it is probably also present in the Cape Verde Islands (A. Brito, pers. comm.). It is proposed for protection in the Canary Islands and included in the Preliminary Red List (Bacallado et al., 1989) and the Annotated Marine Fauna List (Bonnet-Fernández-Trujillo and Rodríguez-Fernández, 1992). We strongly [illegible] environmental authorities of the Canary [illegible] to include *Coralliophila kaofitorum* [illegible] species, since it is up to now only [illegible] Islands and is strictly associated [illegible]

ACKNOWLEDGMENTS

We are [illegible] Criterio for information about the [illegible] and to him and Alexandra Richter for [illegible] comments on the manuscript; to Gustavo Pen[illegible] data on coralliophilids from the Canary [illegible] Jesús Bedoya (MNCN) for SEM photographs, and to Rogelio Sánchez and Jesús Muñoz (MNCN) for photographs; to Alberto Brito and Rogelio Herrera for information about conservation. This work was supported by Fauna Ibérica IV project (DGICYT PB95-0235).

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